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SPATIAL GRID FOR ESTIMATION OF THERMAL FIELDS IN GLASS MOLDS

A. I. Shutov,[1] N. D. Vorob'ev,[1] A. I. Nepomnyashchii,[1] A. S. Ostapko,[1] A. S. Blintsovskii,[1] K. G. Gunchenko,[1] and V. I. Yagnyuk[1]

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Methods for imposition of a multidimensional grid on a set of molds of arbitrary shapes are considered.

Molding of glass articles is a complex physicochemical and thermal process.

A glass-shaping mold imparts the needed configuration to the glass drop and simultaneously chills the fluid glass. In the course of designing a glass mold, the thermal fields of mold parts are not calculated, due to the complex geometrical shape of the parts and the high rate of thermal processes occurring in them. The existent practical methods make it possible to estimate the average temperature conditions in the glass mold for a molding cycle, under the assumption that the molding cycle is stationary [1, 2]. A mathematical model for the temperature conditions in glass molds in molding of glass articles on an APP-12 press machine is constructed in [3].

The selected numerical method was the finite difference method, whose algorithms are widely used in calculations of thermal fields in other branches of engineering. The glass mold design environment was the AutoCAD 2000. AutoCAD is actually the standard environment in computer-aided design systems.

The following phases are suggested:

– imposition of a three-dimensional grid on glass mold parts;

– development of a mathematical model, discretization of differential equations, and carrying out a numerical experiment;

– interpretation of the numerical experimental results.

The present paper considers the procedure of imposition of a multidimensional grid on the mold of an arbitrary configuration and selection of appropriate software.

The algorithms of the grid imposition are as follows:

(1) the grid boundaries (usually, a cube) and the steps on axes x, y, and z are set;

(2) all coordinates of a point are calculated, and then the point is correlated to a specific mold part;

(3) the above data are stored in the database for subsequent calculations;

(4) items 2 and 3 are repeated for the next point of the grid.

The following methods for determination of the correlation of grid points with mold parts were developed and tested.

Volume correlation method. The method consists in the correlation of the initial volume of the mold part with the volume of the body resulting after a sphere of small radius is cut out of that part. If the volumes turn out to be different, it is concluded that the point belongs to the mold part (Fig. 1). This operation is performed for all parts of the mold. The software used: Visual C++ 6.0; AutoCAD 2000.

The method proved to be inefficient due to the low data processing speed (as the data are copied on the disk and then read). The correlation of 10^6 points with mold parts and storing the data in the database took 54 days (all tests were carried out on a Pentium 133 with 16M RAM).

Intersection method. The essence of the method consists in the logical identification of the intersection of a mold

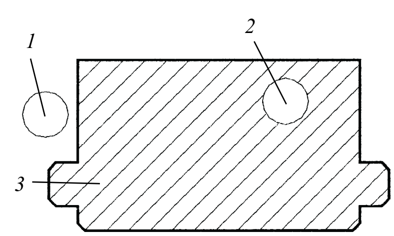

Fig. 1. Determination of the correlation of a point with a mold part using the volume correlation method: *1*) sphere in a point not belonging to the mold part; *2*) sphere in a point inside the body; *3*) mold part.

[1] Belgorod State Technological Academy of Construction Materials, Belgorod, Russia.

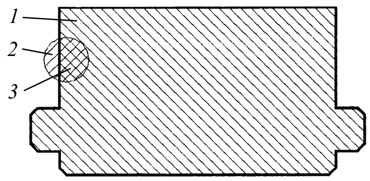

Fig. 2. Determination of the correlation of a point with a mold part using the intersection method: *1*) mold part; *2*) sphere surrounding a point; *3*) a body resulting from the intersection of the sphere with the mold part.

part and a small-radius sphere whose center is in the grid node. The intersection of two bodies produces a third body, which makes it possible to determine the correlation between the point and the body (Fig. 2). This operation is performed for all parts of the mold. The software used: Visual Basic 6.0 and AutoCAD 2000.

The proposed method ensures a high processing rate. The correlation of 10^6 points with mold parts and their storage in the database is performed in 8 h.

To increase the calculation accuracy, it is possible to vary the mesh size or vary the scale of the mold parts and the sphere.

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